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(54) 【発明の名称】 中空糸膜モジュールの洗浄方法

(57) 【要約】

【効果】 微粒子や懸濁物質を含んだ液体をろ過し、定期的に行なう空気スクラビングによる洗浄時間を短縮することが可能な中空糸膜モジュールの洗浄方法が提供される。

【構成】 空気スクラビングを行った後、容器内を加圧した状態で排水を行うことを特徴とする中空糸膜モジュールの洗浄方法。

## 【特許請求の範囲】

【請求項 1】 空気スクラビングを行った後、容器内を加圧した状態で排水を行うことを特徴とする中空糸膜モジュールの洗浄方法。

【請求項 2】 空気スクラビングを行った後、容器内を 0.05 kqf/cm<sup>2</sup> ～ 5 kqf/cm<sup>2</sup> に加圧した状態で排水を行うことを特徴とする中空糸膜モジュールの洗浄方法。

【請求項 3】 原液供給口、空気供給口、排水口、空気抜き口、ろ過水取り出し口を有した中空糸膜モジュールを使用して、空気抜き口、排水口、空気抜き口を閉じて原液のろ過運転を行った後で、空気スクラビング工程と排水工程からなる空気洗浄操作により中空糸膜のろ過性能回復を行う中空糸膜モジュールの洗浄方法において、排水口を閉じ、空気供給口と空気抜き口を開いて空気スクラビングを行った後、排水口を開き、空気抜き口を閉じ、かつ空気供給口を開いて容器内を供給空気により加圧した状態で排水を行うことを特徴とする中空糸膜モジュールの洗浄方法。

【請求項 4】 中空糸膜モジュールの中空糸膜束と容器が接着剤で一体に固定されていることを特徴とする請求項 1 記載の中空糸膜モジュールの洗浄方法。

【請求項 5】 中空糸膜モジュールを構成する中空糸膜が、アクリロニトリルを少なくとも 1 成分とする重合体からなることを特徴とする請求項 1 記載の中空糸膜モジュールの洗浄方法。

## 【発明の詳細な説明】

## 【0001】

【産業上の利用分野】 本発明は、液体のろ過操作を行なうための中空糸膜モジュールに関する。

## 【0002】

【従来の技術】 一般の工業用水には、多くの SS 成分、微粒子、ゴミ、細菌類、藻類、などが含まれており、このまま使用されると、用水配管の詰まり、細菌の増殖、ライン中のスケール堆積などのトラブルを生じる原因となりやすい。従来、これらの水中混入成分を除去するために、砂ろ過、凝集ろ過、凝集沈殿ろ過、カートリッジろ過などの各種方法が用途に応じて使用されてきた。これらの一般ろ過法に変わる新規な手法として、最近では多孔質の中空糸膜によるろ過が実用化され始めつつある。中空糸膜による水処理、ろ過は、近年急速に普及し、その適用分野も年々広がりつつある。

【0003】 中空糸膜のろ過において、中空糸膜は何千～何万本を束に束ねた後に端部を接着剤で固定した形状の商品形態に加工される。そして、これらの商品形態に加工されたものは、中空糸膜モジュールと呼ばれている。液体のろ過が可能な中空糸膜モジュールとしては従来から多くの形態のものが提案されている。特に初期のものとしては、適度な前処理手段と組み合わせ使用されるろ過モジュール、逆浸透ろ過を目的としたもの、透

析用途を目的としたものなどがあり、これらの用途を主目的として、多くのモジュール形態が提案されており、その主なものを挙げると、特公昭 48-28380 号公報、特開昭 49-69550 号公報、特開昭 53-100176 号公報、などに記載されているものがある。これらは、全て、液体のろ過を実施するにあたり、使い捨て、あるいは、汚れが一定量以上付着した段階において、清澄水または薬液水による洗浄やフラッシング処理を実施するのが普通であった。

【0004】 これに対して、最近では、中空糸膜モジュール形状に工夫をこらし、エアーにより中空糸膜の性能回復を実施する方法が試みられている。特開昭 61-263605 号公報は、中空糸膜を U 字型に組み込み、容器に収納して使用するものであり、定期的に容器の下部に設けられたエアー導入口からエアーを導入させてエアースクラビングにより中空糸膜を振動させ、膜面の堆積物の除去を試みるものである。また、特開昭 60-206415 号公報は、中空糸膜を中心パイプの回りに配列させた両端固定型モジュールであり、前記同様に容器に組み込み、エアースクラビングにより中空糸膜膜面の堆積物を除去するものである。これらの技術は、既に実用化の検討が開始されている。

【0005】 また、モジュール構造の簡素化とエアースクラビング効果の向上を狙い、中空糸膜束の中心にスクラビングエアー供給口を有した中心パイプを設けたモジュールも使用されている（特開平 5-096136）。

## 【0006】

【発明が解決しようとする課題】 中空糸膜モジュールの運転では、ろ過操作を継続していると膜面にゴミ、浮遊物等が付着してろ過圧力が上昇するため定期的に物理洗浄操作を行い膜面の付着成分を除去する必要がある。物理洗浄操作の実施時期については、一定時間毎に物理洗浄操作を行う場合や一定圧力に到達すれば物理洗浄操作を行う場合などが一般的であるが、現状の洗浄操作では、下記の課題が残されている。すなわち、洗浄操作は、ろ過操作を停止し実施するため効率の面からみてもできるだけ短時間で終了するのが好ましいが、最も効率の高い物理洗浄方法の一つである空気スクラビング洗浄の場合においては、実際は空気スクラビング、排水、給水の各工程の合計が洗浄時間になり、かなりの時間がかかる。

【0007】 洗浄時間は、ろ過操作を停止して行なわれるため、その間ろ過水は供給できなくなるが連続してろ過水の供給必要な場合はろ過水タンクを設け、ポンプにより供給する方法が一般的であり、洗浄時間が短いほうがタンク容積も小さくてすむ。モジュールあるいはモジュールユニットを 2 セット用い、ろ過と洗浄をそれぞれ交互に行なう方法も採用されているがろ過水が連続的に得られる反面、装置が大きくなりコストも高くなる。

【0008】 そこで、洗浄方法の条件検討により洗浄時

間、洗浄間隔、洗浄空気量等の最適化が行われている。しかし、汚れの多い原水のろ過運転では洗浄に要する時間はかなり長くなるため、洗浄時間の短縮化できる手段が求められていた。

【0009】

【課題を解決するための手段】本発明の目的は、空気スクラビングを行った後、容器内を加圧した状態で排水を行うことにより基本的に達成される。

【0010】特に限定されるものではないが、具体的には、以下の通りである。

【0011】まず、中空糸膜モジュールとしては、原液供給口、空気供給口、排水口、空気抜き口、ろ過水取り出し口を有した中空糸膜モジュールを使用して、空気抜き口、排水口を閉じて原液のろ過運転を行った後で、空気スクラビング工程と排水工程からなる空気洗浄操作により中空糸膜のろ過性能回復を行う中空糸膜モジュールの洗浄方法において、排水口を閉じ、空気供給口と空気抜き口を開いて空気スクラビングを行った後、排水口を開き、空気抜き口を閉じ、かつ空気供給口を開いて容器内を供給空気により加圧した状態で排水を行うことにより達成される。

【0012】

【作用】本発明及び従来例に関わる中空糸膜モジュールを図1に示す。

【0013】ろ過される供給水は多孔質中空糸ろ過膜モジュール（以下中空糸膜モジュールと呼ぶ）の原液供給口3より供給され、中空糸膜の表面に開いている無数の微細孔でろ過されて、SS成分や微粒子や、ごみ、細菌などが除かれた清澄水だけが中空糸膜内部に透過し、ろ過水出口7からろ過水として取り出される。中空糸膜モジュールのろ過においては原水圧力が大きいほどろ過水量は大きくなるが、ろ過時間の経過と共に前記SS成分、微粒子などが膜面に付着して多かれ少なかれ中空糸膜の目詰まりが生じ、同一圧力あたりのろ過水量が徐々に低下していくのが普通である。よって、中空糸膜、モ

ジュールを長期に使用続けていくためには、中空糸膜の目詰まりが進行してろ過水量が低下した適当な時点において、空気スクラビングをはじめとする洗浄操作を行ない、目詰まり前に近いレベルにまで中空糸膜のろ過水量を回復させることが必要となってくる。

【0014】以下に、従来例と本発明の洗浄操作の方法について、図面を用いて説明するが、これにより、特に本発明が限定されるものではない。

【0015】まず、従来例の手順を説明する。図1は一般的なモジュール構造であり容器1に充填された中空糸膜8は、ろ過により膜面の汚れを洗浄するため原液供給口3を閉じ、洗浄用の空気供給口4、空気抜き口5を開け空気スクラビングを行ない膜面の付着物を揺り落とす操作が行なわれる。空気スクラビング終了後、洗浄用空気供給口を閉じ、空気抜き口は開け放たれた状態で、汚れた洗浄液は、排水口6を開け外部に排出される。排出後、原液供給口を開け、原液が容器に充填すれば空気抜き口を閉じ、容器に原液供給圧力がかけられろ過水取り出し口7からろ過水が供給される。通常、膜面の汚れが大きい場合ほど空気スクラビング時間を長く取る必要があり、洗浄頻度も高くなる。河川水、湖水など汚れの大きい原液は、ろ過時間30～60分に対して、洗浄時間5分～10分も必要であった。

【0016】これに対して、本発明では、次のように操作を改良した。すなわち、上記の従来例の洗浄用空気を空気供給口4より供給しながら排水口6を開け排水を行なう操作において、本願では、空気抜き口5を閉じた状態にする。これにより、容器1内の汚れた洗浄液が洗浄用空気に押され加圧状態で排出されるため洗浄用空気加圧がない場合に比べて早くなり、空気を供給しない通常の排水操作に比べて著しく洗浄時間が短くなる。

【0017】表1は、以上の本発明の方法を用いた洗浄操作手順と従来例の操作手順を比較したものである。

【0018】

【表1】

表1 本発明操作手順

	本発明操作手順				従来操作手順			
	ろ過操作		洗浄操作		ろ過操作		洗浄操作	
	スタート (通水)	通	空気スクラ ビング	排水	スタート (通水)	通	空気スクラ ビング	排水
原液供給口	閉	開	閉	閉	閉	開	閉	開
空気抜き口	閉	閉	開	閉	閉	閉	開	閉
洗浄用空気供給口	閉	閉	開	閉	閉	閉	開	閉
排水口	閉	閉	閉	開	閉	閉	閉	開
ろ過水取り出し口	閉	閉	閉	開	閉	閉	開	閉

なお、図面としては、図1のように、原液供給口、空気供給口、排水口、空気抜き口、ろ過水取り出し口がそれぞれ独立に容器へ直結された中空糸膜モジュールの例を  
40 図示したが、本発明の方法はかかる構造に限定されるものではなく、例えば、原液供給口、空気供給口、排水口、が途中で1つにまとまり、1本のパイプとなって容器へ接続している形態のモジュールであっても、本発明の方法を行うのに何ら障害ではない。

【0019】空気加圧時の容器内圧力（大気圧との圧力差）は中空糸膜を損傷しない程度であることが必要であり、適宜は0.05 k<sub>gf</sub>/cm<sup>2</sup>～5 k<sub>gf</sub>/cm<sup>2</sup>が好ましく、経済性、容器耐圧を考察すると、0.1 k<sub>gf</sub>/cm<sup>2</sup>～2.0 k<sub>gf</sub>/cm<sup>2</sup>程度が特に好ましい。

【0020】モジュール本数が1本の場合もさることながら、大型モジュールやモジュールを何本も充填した容器内の汚れた洗浄液を排水する場合の効果は大きい。

【0021】このように、本願方法の洗浄操作により、洗浄時間を大幅に短縮することが可能となる方法を見出した。

【0022】モジュール構造は、中空糸膜モジュールで空気スクラビングによる物理洗浄が可能な形態であれば特に限定するものではない。しかしながら、好ましくは中空糸膜束と容器が接着剤で一体に固定されており、中心パイプから周方向外部に向けて均一に空気が供給される構造のものが好ましい。

50 【0023】洗浄用空気量は、モジュールの大きさや膜

# PATENT ABSTRACTS OF JAPAN

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(71)Applicant : **TORAY IND INC**

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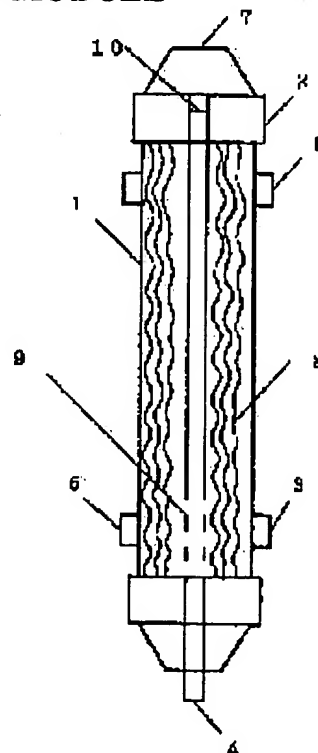
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## (54) CLEANING METHOD OF HOLLOW FIBER MEMBRANE MODULE

(57)Abstract:

**PURPOSE:** To optimize the cleaning time, cleaning interval, and amt. of air for cleaning and to decrease the cleaning time by discharging water while the inside of the chamber is pressurized after air scrubbing is performed.

**CONSTITUTION:** When raw water is introduced through a raw liquid supply port 3 of a porous hollow fiber membrane module, the SS component and fine particles are separated by filtering with fine pores on the surface of the hollow fiber membrane 8 and only clear water permeates through the membrane and is discharged through an exit 7. When the filtering pressure is increased, the supply port 3 is closed and an air supply port 4 and a deaerating port 5 for cleaning are opened to perform air scrubbing so as to drop the deposited matter on the membrane by vibration. Then the deaerating port is closed so that the cleaning liquid in the chamber 1 is pressurized by the cleaning air into an pressurized state. Then, a discharge port 6 is opened to discharge water.



## LEGAL STATUS

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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE  
INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF  
DRAWINGS DRAWINGS

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**CLAIMS**

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[Claim(s)]

[Claim 1] A washing method of a hollow fiber module characterized by draining where the inside of a container is pressurized after performing air scrubbing.

[Claim 2] They are 0.05 kgf / cm<sup>2</sup> - 5 kgf / cm<sup>2</sup> about the inside of a container after performing air scrubbing. A washing method of a hollow fiber module characterized by draining in the condition of having pressurized.

[Claim 3] After using a hollow fiber module with an undiluted solution feed hopper, air supply opening, an exhaust port, air vent opening, and filtered water output port, closing air vent opening, an exhaust port, and air vent opening and performing filtration operation of an undiluted solution In a washing method of a hollow fiber module that air wash actuation which consists of an air scrubbing production process and a drainage work degree performs filtration engine-performance recovery of a hollow fiber A washing method of a hollow fiber module characterized by draining where it opened an exhaust port for an aperture, it opened closing and air supply opening for air vent opening and the inside of a container is pressurized by supply air, after opening an exhaust port for closing, air supply opening, and air vent opening and performing air scrubbing.

[Claim 4] A washing method of a hollow fiber module according to claim 1 characterized by fixing a hollow fiber bunch and a container of a hollow fiber module to one with adhesives.

[Claim 5] A washing method of a hollow fiber module according to claim 1 characterized by a hollow fiber which constitutes a hollow fiber module consisting of a polymer which uses acrylonitrile as at least 1 component.

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**DETAILED DESCRIPTION**

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[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the hollow fiber module for performing filtration actuation of a liquid.

[0002]

[Description of the Prior Art] if many SS components, a particle, dust, bacteria, algae, etc. are contained in common industrial water and it is used as it is -- service water -- it is easy to become the cause which produces troubles, such as plugging of piping, bacterial growth, and scale deposition in Rhine. In order to remove these underwater mixing components conventionally, various methods, such as sand filtration, condensation filtration, coagulation sedimentation filtration, and cartridge filtration, have been used according to a use. Filtration by the porous hollow fiber is beginning to put in practical use as the new technique of changing to such general filtration recently. The water treatment by the hollow fiber and filtration spread quickly in recent years, and are becoming large [ the Field of application ] every year.

[0003] In filtration of a hollow fiber, after a hollow fiber bundles what 1000 - what [ 10,000 ] in a bunch, it is processed into the goods gestalt of the configuration which fixed the edge with adhesives. And what was processed into these goods gestalten is called the hollow fiber module. As a hollow fiber module which can filter a liquid, the thing of many gestalten is proposed from the former. There are a filtration module used especially as an early thing combining a moderate pretreatment means, a thing aiming at reverse osmosis filtration, a thing aiming at a dialysis use, etc., many module gestalten are proposed by making these uses into a key objective, and when the main thing is mentioned, there are some which are indicated by JP,48-28380,B, JP,49-69550,A, JP,53-100176,A, etc. As for these all, in filtering a liquid, in throwing away or the phase in which dirt adhered more than the constant rate, it was common to have carried out washing and the Flushing processing by clarified water or drug solution water.

[0004] On the other hand, a hollow fiber module configuration is elaborated recently and the method of carrying out engine-performance recovery of a hollow fiber by Ayr is tried. JP,61-263605,A includes a hollow fiber in a U character mold, contains and uses it for a container, makes Ayr introduce from the Ayr inlet periodically established in the lower part of a container, vibrates a hollow fiber by Ayr scrubbing, and tries removal of the sediment of a film surface. Moreover, JP,60-206415,A is the both-ends cover-half module which made the hollow fiber arrange around a central tube, and is said thing which includes in a container similarly and removes the sediment of a hollow fiber film surface by Ayr scrubbing. As for such technology, examination of utilization is already started.

[0005] Moreover, the simplification of module structure and improvement in the Ayr scrubbing effect are aimed at, and the module which prepared the central tube with a scrubbing air feed hopper in the center of a hollow fiber bunch is also used (publication number 5-096136).

[0006]

[Problem(s) to be Solved by the Invention] Since dust, suspended matter, etc. will adhere to a film surface and filtration pressure will rise if filtration actuation is continued, it is necessary to perform physical washing actuation periodically and to remove the adhesion component of a film surface in operation of a hollow fiber module. About the operation stage of physical washing actuation, although the case where physical washing actuation is performed etc. is common if the case where physical washing actuation is performed for every fixed

time amount, and a constant pressure are reached, the following technical problem is left behind by the present washing actuation. That is, although it is desirable to end as much as possible also seen from the field of effectiveness for a short time as for washing actuation in order to suspend and carry out filtration actuation, in air scrubbing washing which is one of the physical washing methods that effectiveness is the highest, the sum total of each production process of air scrubbing, wastewater, and water supply becomes washing time amount in practice, and it requires most time amount.

[0007] since washing time amount suspends filtration actuation and is performed, although it becomes impossible to supply filtered water, continue in the meantime -- supply of a filtered water -- when required, a filtrate tank is formed, the method of supplying with a pump is common, and the one of tank capacity where washing time amount is shorter is small, and ends. Although the method of performing filtration and washing by turns, respectively is also adopted, while filtered water is obtained continuously, using a module or a module unit two sets, equipment becomes large and cost also becomes high.

[0008] Then, optimization of washing time amount, a washing gap, a washing air content, etc. is performed by condition examination of the washing method. However, in filtration operation of raw water with much dirt, since the time amount which washing takes became quite long, the means which can shorten washing time amount was searched for.

[0009]

[Means for Solving the Problem] The purpose of this invention is fundamentally attained by draining, where the inside of a container is pressurized, after performing air scrubbing.

[0010] Although not limited especially, specifically, it is as follows.

[0011] First, after using a hollow fiber module with an undiluted solution feed hopper, air supply opening, an exhaust port, air vent opening, and filtered water output port as a hollow fiber module, closing air vent opening and an exhaust port and performing filtration operation of an undiluted solution In a washing method of a hollow fiber module that air wash actuation which consists of an air scrubbing production process and a drainage work degree performs filtration engine-performance recovery of a hollow fiber After opening an exhaust port for closing, air supply opening, and air vent opening and performing air scrubbing, it is attained by draining, where it opened an exhaust port for an aperture, it opened closing and air supply opening for air vent opening and the inside of a container is pressurized by supply air.

[0012]

[Function] The hollow fiber module in connection with this invention and the conventional example is shown in drawing 1 .

[0013] The feedwater filtered is supplied from the undiluted solution feed hopper 3 of a porosity hollow filament filtration membrane module (it is called a hollow fiber module below), is filtered by the countless micropore currently opened on the surface of the hollow fiber, and only the clarified water with which SS component, a particle, a contaminant, bacteria, etc. were removed penetrates it inside a hollow fiber, and it is taken out from the filtered water outlet 7 as filtered water. Although the amount of filtered water becomes large so that a raw water pressure is large in filtration of a hollow fiber module, said SS component, a particle, etc. adhere to a film surface with the filtration passage of time, the blinding of a hollow fiber arises to some extent, and, usually the amount of filtered water per same pressure falls gradually. Therefore, when [ suitable ] the blinding of a hollow fiber advances to eye a use \*\*\*\*\* many and the amount of filtered water falls a hollow fiber and a module to it at a long period of time, washing actuation including air scrubbing is performed, and it is necessary even for level near before blinding to recover the amount of filtered water of a hollow fiber.

[0014] Although the conventional example and the method of washing actuation of this invention are explained below using a drawing, thereby, especially this invention is not limited.

[0015] First, the procedure of the conventional example is explained. In order that the hollow fiber 8 with which drawing 1 is general module structure and the container 1 was filled up may wash the dirt of a film surface by filtration, closing, the air supply opening 4 for washing, and the air vent opening 5 are opened for the undiluted solution feed hopper 3, air scrubbing is performed, and \*\*\*\*\* and \*\*\*\*\* are performed in the affix of a film surface. After air scrubbing termination, where closing and air vent opening are wide opened in air supply opening for washing, the unclean penetrant remover opens an exhaust port 6, and is discharged outside. If an undiluted solution feed hopper is opened after discharge and a container is filled with an undiluted solution, an undiluted solution supply pressure will be applied to closing and a container in air vent opening, and filtered



図1		原液供給	空気抜き	洗剤用空	排水口	ろ過水取
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In addition, although an undiluted solution feed hopper, air supply opening, an exhaust port, air vent opening, and filtered water output port illustrated as a drawing the example of the hollow fiber module directly linked with the container independently, respectively like drawing 1 that by which the method of this invention is limited to this structure -- it is not -- for example, undiluted solution feed hopper, air supply opening, and exhaust-port \*\* -- on the way -- even if it is the module of a gestalt which was collected into coming out one, became one pipe, and has been connected to a container, it is not a failure at all performing the method of this invention.

[0019] It is required to be the degree which does not damage a hollow fiber, and the container internal pressure at the time of air pressurization (differential pressure with atmospheric pressure) is usually 0.05 kgf / cm<sup>2</sup> - 5 kgf / cm<sup>2</sup>. When it is desirable and economical efficiency and container pressure-proofing are considered, they are 0.1 kgf / cm<sup>2</sup> - 2.0 kgf / cm<sup>2</sup>. Especially a degree is desirable.

[0020] Also when a module number is one, the effect in the case of draining the penetrant remover in which it became dirty in the container filled up also with a large-sized module or many modules with last thing is large.

[0021] Thus, the method of becoming possible [ shortening washing time amount sharply ] by washing actuation of this application method was found out.

[0022] By the hollow fiber module, module structure will not be limited, especially if it is the gestalt in which physical washing by air scrubbing is possible. However, the hollow fiber bunch and the container are being preferably fixed to one with adhesives, and the thing of the structure where air is supplied to homogeneity towards the hoop direction exterior from a central tube is desirable.

[0023] The air content for washing is 2 the outer diameter of 100mm, a length of 1100mm, and 12m of film surface products, although it changes with dirt condition of modular magnitude or a film surface. By the module, by 10N l./, about a -50N l./minute is desirable still more desirable, and the amount of -40N l./is good by 20N l./ (N liter means the volume at the time of reference condition [1atm, 0 degree C] here.)

Although washing time amount changes with the water quality and dirt degree of an undiluted solution, and filtration time amount, it is usually good at about 1 - 20 minutes, and if filtration time amount is shortened, it can also shorten washing time amount. However, since the recovery of an undiluted solution will fall if filtration time amount is shortened and the count of washing is made [ many ], it is not desirable. Generally, it filters with the raw water of about 0.1 - one turbidity for 12 to 24 hours, carries out about 5 - 20 minutes of washing time amount, filters in the raw water of about one - ten turbidity for 0.5 to 1 hour, and is about washing time amount 1-5 minute.

[0024] Although the air scrubbing time amount at the time of washing changes with filtration time amount, its about 1 - 20 minutes are usually common.

[0025] Although there is especially no assignment, and macromolecule resin, such as polyvinyl chloride resin, polycarbonate resin, ABS plastics, and polysulfone resin, is generally preferably used in consideration of an adhesive property with adhesives, metallicity, especially stainless steel are sufficient as the quality of the material of a module container.

[0026] Moreover, as adhesives used in order to paste up the hollow fiber used for this invention, urethane system adhesives, epoxy system adhesives, silicon system adhesives, etc. can be used broadly.

[0027]

[Example]

After being filled up with the hollow fiber bunch which divided 10000 hollow fibers of a polyacrylonitrile with an outer diameter [ example 1 / of 450 micrometers ], and a bore of 350 micrometers into four bundles into a transparence outer case with an outer diameter [ of 104mm ], and a bore of 100mm and carrying out another \*\*\*\* seal of the both ends to 2 times with adhesives, the 2nd seal portion was cut for one of the two of an outer case with the slicing machine, and the hollow fiber bunch was made to puncture. After opening the undiluted solution feed hopper, supplying Lake Biwa water by part for 10l./and air's escaping from it using this hollow fiber module, closing, and 10l. the filtered water for /were obtained for air vent opening. Since it let water flow for 1 hour and the film surface became dirty, after opening closing, air vent opening, and air supply opening for the undiluted solution feed hopper and blowing and carrying out scrubbing of the 30l. air for /for 3

minutes, it was 5 seconds when the penetrant remover which opened and became dirty in closing and an exhaust port about air vent opening was drained performing air supply succeeding. Since it let the lake flow from the undiluted solution feed hopper again and the container was filled after washing, air vent opening has been normally filtered, when it let water flow, closing and.

[0028] After filtering Lake Biwa water similarly for 1 hour and carrying out interspace mind scrubbing of the hollow fiber module used for example of comparison 1 example 1 similarly for 3 minutes, when closing air vent opening drained air supply opening in the state of the open beam, wastewater ended it in 1 minute. Air vent opening after wastewater termination was opened, and since it let the lake flow from the undiluted solution feed hopper again and the container was filled, air vent opening has been normally filtered, when it let water flow, closing and.

[0029]

[Effect of the Invention] The liquid containing a particle or a suspended solid is filtered by this invention, and the washing method of the hollow fiber module which can shorten the washing time amount by air scrubbing performed periodically is offered. Moreover, since whenever [ water rate-of-flow / at the time of wastewater ] is large, it excels also in removal effectiveness, such as precipitate.

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**TECHNICAL FIELD**

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[Industrial Application] This invention relates to the hollow fiber module for performing filtration actuation of a liquid.

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PRIOR ART

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[Description of the Prior Art] if many SS components, a particle, dust, bacteria, algae, etc. are contained in common industrial water and it is used as it is -- service water -- it is easy to become the cause which produces troubles, such as plugging of piping, bacterial growth, and scale deposition in Rhine. In order to remove these underwater mixing components conventionally, various methods, such as sand filtration, condensation filtration, coagulation sedimentation filtration, and cartridge filtration, have been used according to a use. Filtration by the porous hollow fiber is beginning to put in practical use as the new technique of changing to such general filtration recently. The water treatment by the hollow fiber and filtration spread quickly in recent years, and are becoming large [ the Field of application ] every year.

[0003] In filtration of a hollow fiber, after a hollow fiber bundles what 1000 - what [ 10,000 ] in a bunch, it is processed into the goods gestalt of the configuration which fixed the edge with adhesives. And what was processed into these goods gestalten is called the hollow fiber module. As a hollow fiber module which can filter a liquid, the thing of many gestalten is proposed from the former. There are a filtration module used especially as an early thing combining a moderate pretreatment means, a thing aiming at reverse osmosis filtration, a thing aiming at a dialysis use, etc., many module gestalten are proposed by making these uses into a key objective, and when the main thing is mentioned, there are some which are indicated by JP,48-28380,B, JP,49-69550,A, JP,53-100176,A, etc. As for these all, in filtering a liquid, in throwing away or the phase in which dirt adhered more than the constant rate, it was common to have carried out washing and the Flushing processing by clarified water or drug solution water.

[0004] On the other hand, a hollow fiber module configuration is elaborated recently and the method of carrying out engine-performance recovery of a hollow fiber by Ayr is tried. JP,61-263605,A includes a hollow fiber in a U character mold, contains and uses it for a container, makes Ayr introduce from the Ayr inlet periodically established in the lower part of a container, vibrates a hollow fiber by Ayr scrubbing, and tries removal of the sediment of a film surface. Moreover, JP,60-206415,A is the both-ends cover-half module which made the hollow fiber arrange around a central tube, and is said thing which includes in a container similarly and removes the sediment of a hollow fiber film surface by Ayr scrubbing. As for such technology, examination of utilization is already started.

[0005] Moreover, the simplification of module structure and improvement in the Ayr scrubbing effect are aimed at, and the module which prepared the central tube with a scrubbing air feed hopper in the center of a hollow fiber bunch is also used (publication number 5-096136).

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**EFFECT OF THE INVENTION**

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[Effect of the Invention] The liquid containing a particle or a suspended solid is filtered by this invention, and the washing method of the hollow fiber module which can shorten the washing time amount by air scrubbing performed periodically is offered. Moreover, since whenever [ water rate-of-flow / at the time of wastewater ] is large, it excels also in removal effectiveness, such as precipitate.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention] Since dust, suspended matter, etc. will adhere to a film surface and filtration pressure will rise if filtration actuation is continued, it is necessary to perform physical washing actuation periodically and to remove the adhesion component of a film surface in operation of a hollow fiber module. About the operation stage of physical washing actuation, although the case where physical washing actuation is performed etc. is common if the case where physical washing actuation is performed for every fixed time amount, and a constant pressure are reached, the following technical problem is left behind by the present washing actuation. That is, although it is desirable to end as much as possible also seen from the field of effectiveness for a short time as for washing actuation in order to suspend and carry out filtration actuation, in air scrubbing washing which is one of the physical washing methods that effectiveness is the highest, the sum total of each production process of air scrubbing, wastewater, and water supply becomes washing time amount in practice, and it requires most time amount.

[0007] since washing time amount suspends filtration actuation and is performed, although it becomes impossible to supply filtered water, continue in the meantime -- supply of a filtered water -- when required, a filtrate tank is formed, the method of supplying with a pump is common, and the one of tank capacity where washing time amount is shorter is small, and ends. Although the method of performing filtration and washing by turns, respectively is also adopted, while filtered water is obtained continuously, using a module or a module unit two sets, equipment becomes large and cost also becomes high.

[0008] Then, optimization of washing time amount, a washing gap, a washing air content, etc. is performed by condition examination of the washing method. However, in filtration operation of raw water with much dirt, since the time amount which washing takes became quite long, the means which can shorten washing time amount was searched for.

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MEANS

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[Means for Solving the Problem] The purpose of this invention is fundamentally attained by draining, where the inside of a container is pressurized, after performing air scrubbing.

[0010] Although not limited especially, specifically, it is as follows.

[0011] First, after using a hollow fiber module with an undiluted solution feed hopper, air supply opening, an exhaust port, air vent opening, and filtered water output port as a hollow fiber module, closing air vent opening and an exhaust port and performing filtration operation of an undiluted solution In a washing method of a hollow fiber module that air wash actuation which consists of an air scrubbing production process and a drainage work degree performs filtration engine-performance recovery of a hollow fiber After opening an exhaust port for closing, air supply opening, and air vent opening and performing air scrubbing, it is attained by draining, where it opened an exhaust port for an aperture, it opened closing and air supply opening for air vent opening and the inside of a container is pressurized by supply air.

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OPERATION

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[Function] The hollow fiber module in connection with this invention and the conventional example is shown in drawing 1.

[0013] The feedwater filtered is supplied from the undiluted solution feed hopper 3 of a porosity hollow filament filtration membrane module (it is called a hollow fiber module below), is filtered by the countless micropore currently opened on the surface of the hollow fiber, and only the clarified water with which SS component, a particle, a contaminant, bacteria, etc. were removed penetrates it inside a hollow fiber, and it is taken out from the filtered water outlet 7 as filtered water. Although the amount of filtered water becomes large so that a raw water pressure is large in filtration of a hollow fiber module, said SS component, a particle, etc. adhere to a film surface with the filtration passage of time, the blinding of a hollow fiber arises to some extent, and, usually the amount of filtered water per same pressure falls gradually. Therefore, when [ suitable ] the blinding of a hollow fiber advances to eye a use \*\*\*\*\* many and the amount of filtered water falls a hollow fiber and a module to it at a long period of time, washing actuation including air scrubbing is performed, and it is necessary even for level near before blinding to recover the amount of filtered water of a hollow fiber.

[0014] Although the conventional example and the method of washing actuation of this invention are explained below using a drawing, thereby, especially this invention is not limited.

[0015] First, the procedure of the conventional example is explained. In order that the hollow fiber 8 with which drawing 1 is general module structure and the container 1 was filled up may wash the dirt of a film surface by filtration, closing, the air supply opening 4 for washing, and the air vent opening 5 are opened for the undiluted solution feed hopper 3, air scrubbing is performed, and \*\*\*\*\* and \*\*\*\*\* are performed in the affix of a film surface. After air scrubbing termination, where closing and air vent opening are wide opened in air supply opening for washing, the unclean penetrant remover opens an exhaust port 6, and is discharged outside. If an undiluted solution feed hopper is opened after discharge and a container is filled with an undiluted solution, an undiluted solution supply pressure will be applied to closing and a container in air vent opening, and filtered water will be supplied from filtered water output port 7. Usually, the case where the dirt of a film surface is larger needs to take long air scrubbing time amount, and washing frequency also becomes high. Washing time amount 5 minutes -, and no less than 10 minutes were required for the large undiluted solution of dirt, such as river water and a lake, to the filtration time amount 30 - 60 minutes.

[0016] On the other hand, in this invention, actuation was improved as follows. namely, the actuation which drains by opening an exhaust port 6 while supplying the air for washing of the above-mentioned conventional example from the air supply opening 4 -- it is and changes into the condition of having closed the air vent opening 5, in this application. Since the penetrant remover in which it became dirty in the container 1 is pushed on the air for washing and discharged in the state of pressurization by this, compared with the case where there is no air pressurization for washing, it becomes early, and compared with the usual wastewater actuation which does not supply air, washing time amount becomes short remarkably.

[0017] A table 1 compares with the conventional operating procedure the washing operating procedure which used the method of the above this invention.

[0018]

表 1 本発明操作手順

	本発明操作手順						従来操作手順			
	ろ過操作			洗浄操作			ろ過操作		洗浄操作	
	スタート (通水)	ろ過	空気スクリュー ラビング	排水	通水	スタート (通水)	ろ過	空気スクリュー ラビング	排水	通水
原液供給口	開	開	閉	閉	開	開	開	閉	閉	開
空気抜き口	開	閉	閉	閉	開	開	閉	閉	閉	開
洗浄用空気供給口	閉	閉	閉	閉	閉	閉	閉	閉	閉	閉
排水口	閉	閉	閉	閉	閉	閉	閉	閉	閉	閉
ろ過水取り出し口	開	開	開	開	開	開	開	開	開	開

In addition, although an undiluted solution feed hopper, air supply opening, an exhaust port, air vent opening, and filtered water output port illustrated as a drawing the example of the hollow fiber module directly linked with the container independently, respectively like drawing 1 that by which the method of this invention is limited to this structure -- it is not -- for example, undiluted solution feed hopper, air supply opening, and exhaust-port \*\* -- on the way -- even if it is the module of a gestalt which was collected into coming out one, became one pipe, and has been connected to a container, it is not a failure at all performing the method of this invention. [0019] It is required to be the degree which does not damage a hollow fiber, and the container internal pressure at the time of air pressurization (differential pressure with atmospheric pressure) is usually 0.05 kgf /

cm<sup>2</sup> - 5 kgf / cm<sup>2</sup>. When it is desirable and economical efficiency and container pressure-proofing are considered, they are 0.1 kgf / cm<sup>2</sup> - 2.0 kgf / cm<sup>2</sup>. Especially a degree is desirable.

[0020] Also when a module number is one, the effect in the case of draining the penetrant remover in which it became dirty in the container filled up also with a large-sized module or many modules with last thing is large.

[0021] Thus, the method of becoming possible [ shortening washing time amount sharply ] by washing actuation of this application method was found out.

[0022] By the hollow fiber module, module structure will not be limited, especially if it is the gestalt in which physical washing by air scrubbing is possible. However, the hollow fiber bunch and the container are being preferably fixed to one with adhesives, and the thing of the structure where air is supplied to homogeneity towards the hoop direction exterior from a central tube is desirable.

[0023] The air content for washing is 2 the outer diameter of 100mm, a length of 1100mm, and 12m of film surface products, although it changes with dirt condition of modular magnitude or a film surface. By the module, by 10N l./, about a -50N l./minute is desirable still more desirable, and the amount of -40N l./is good by 20N l./ (N liter means the volume at the time of reference condition [1atm, 0 degree C] here.)

Although washing time amount changes with the water quality and dirt degree of an undiluted solution, and filtration time amount, it is usually good at about 1 - 20 minutes, and if filtration time amount is shortened, it can also shorten washing time amount. However, since the recovery of an undiluted solution will fall if filtration time amount is shortened and the count of washing is made [ many ], it is not desirable. Generally, it filters with the raw water of about 0.1 - one turbidity for 12 to 24 hours, carries out about 5 - 20 minutes of washing time amount, filters in the raw water of about one - ten turbidity for 0.5 to 1 hour, and is about washing time amount 1-5 minute.

[0024] Although the air scrubbing time amount at the time of washing changes with filtration time amount, its about 1 - 20 minutes are usually common.

[0025] Although there is especially no assignment, and macromolecule resin, such as polyvinyl chloride resin, polycarbonate resin, ABS plastics, and polysulfone resin, is generally preferably used in consideration of an adhesive property with adhesives, metallicity, especially stainless steel are sufficient as the quality of the material of a module container.

[0026] Moreover, as adhesives used in order to paste up the hollow fiber used for this invention, urethane system adhesives, epoxy system adhesives, silicon system adhesives, etc. can be used broadly.

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**EXAMPLE**

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[Example]

After being filled up with the hollow fiber bunch which divided 10000 hollow fibers of a polyacrylonitrile with an outer diameter [ example 1 / of 450 micrometers ], and a bore of 350 micrometers into four bundles into a transperance outer case with an outer diameter [ of 104mm ], and a bore of 100mm and carrying out another \*\*\*\* seal of the both ends to 2 times with adhesives, the 2nd seal portion was cut for one of the two of an outer case with the slicing machine, and the hollow fiber bunch was made to puncture. After opening the undiluted solution feed hopper, supplying Lake Biwa water by part for 10l./and air's escaping from it using this hollow fiber module, closing, and 10l. the filtered water for /were obtained for air vent opening. Since it let water flow for 1 hour and the film surface became dirty, after opening closing, air vent opening, and air supply opening for the undiluted solution feed hopper and blowing and carrying out scrubbing of the 30l. air for /for 3 minutes, it was 5 seconds when the penetrant remover which opened and became dirty in closing and an exhaust port about air vent opening was drained performing air supply succeedingly. Since it let the lake flow from the undiluted solution feed hopper again and the container was filled after washing, air vent opening has been normally filtered, when it let water flow, closing and.

[0028] After filtering Lake Biwa water similarly for 1 hour and carrying out interspace mind scrubbing of the hollow fiber module used for example of comparison 1 example 1 similarly for 3 minutes, when closing air vent opening drained air supply opening in the state of the open beam, wastewater ended it in 1 minute. Air vent opening after wastewater termination was opened, and since it let the lake flow from the undiluted solution feed hopper again and the container was filled, air vent opening has been normally filtered, when it let water flow, closing and.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is an example of the hollow fiber module used by this invention.

[Description of Notations]

- 1: Container
- 2: Cap
- 3: Undiluted solution feed hopper
- 4: Air supply opening
- 5: Air vent opening
- 6: Exhaust port
- 7: Filtered water output port
- 8: Hollow fiber
- 9: Air-outlet hole
- 10: Plug

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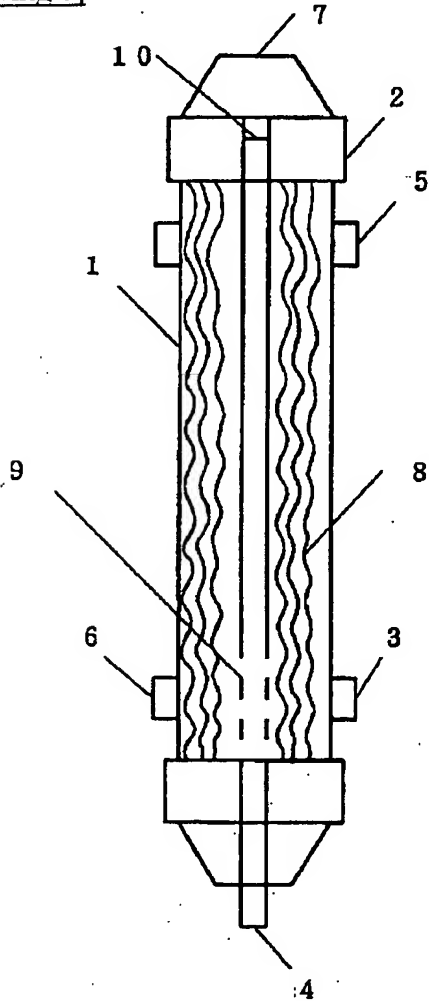
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DRAWINGS

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[Drawing 1]



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